Figure 6 shows the blank of Figure 5 having been formed to the required three-dimensional shaped bracket;

Figure 7 shows the bracket of Figure 6 on a forming tool used to bend the blank of Figure 6 to the required three-dimensional shape;

Figure 8 shows a finished bracket according to the present invention;

Figure 9 shows a finished bracket according to the present invention having two fold lines about which the bracket has been bent;

Figure 10 shows a blank from which the bracket of Figure 9 could be formed.

Referring firstly to Figures 1 to 3, examples of brackets used in aircraft manufacture as well as other constructions are shown. Figures 1a and 1b show an angle bracket 10 used to joint two components (not shown), the components being attached to surfaces 12 and 14 with fasteners such as bolts and nuts 16, through holes 18a, 18b drilled in the bracket 10.

Figures 2a and 2b show a box bracket 20 used to join at least two components, the components being attached at surfaces 22, 24, 26, 28.

Figures 3a and 3b show a butterfly bracket 30 used to join at least two components, the components being attached at surfaces 32 and 34.

Figure 4 shows how complex structures can be joined using brackets as described above.

Part of a wing box 40 is constructed using butterfly brackets, 42a, 42b, 42c, to join stringers 44a, 44b, 44c to rib 46.

Figure 5 shows a blank 50 in accordance with the present invention cut from a sheet of composite material with a resin matrix. A fold line 52 defining regions 54 and 56 is marked on the upper surface of the blank to act as a guide during the subsequent bending operation. The blank 50 is substantially 'Z'-shaped. This shape allows a bracket suitable for use where a butterfly bracket 30 according to the prior art would previously have been used to be formed in a one-stage forming process.

Figure 6 shows the blank 50 having been bent about the fold line 52. Region 54 is no longer in the same plane as region 56. The angle between the two regions 54, 56 can be controlled to create the required three-dimensional shaped bracket.

As the blank is bent about fold line 52 curve 58 is formed. By setting the size of the hinge (not shown) or other bending device used, the angle of curvature of curve 52 can be controlled. If required additional 90° fibres can be included in the lay up of the composite material from which the blank 50 is cut at the location of the curve to provide additional strength characteristics.

Figure 7 shows the blank 50 of Figure 6 on the tooling 70 used to bend the blank 50 to the required bracket shape. The tooling 70 comprises two forming plates 74, 76 attached via a hinge or other hinge-like mechanism that will allow the plates 74, 76 to rotate with respect to each other. In this example plate 76 is held fixed and plate 76 is allowed to rotate about the hinge that has previously been aligned with fold line 52 and the blank 50 secured in position.

Figure 8 shows a finished bracket 80 that has been formed as described above and with fastener holes 82a, 82b, 82c, 82d drilled ready for use.

Figure 9 shows a bracket 90 manufactured according to the invention having two curves 92, 94 and fastener holes 96a, 96b, 96c, 96b.

Figure 10 shows the blank 100 bracket 90 was formed from having two fold lines 102, 104, defining regions, 106, 108, 110 that can be bent to form the required three-dimensionally shaped bracket.

CLAIMS

1. A method of forming a bracket including the steps of:

(i) cutting out a blank, having at least one fold line defining first and second regions of the blank, from a sheet of composite material,

and then, using a forming tool

(ii) undertaking a bending operation to bend the blank about the at least one fold line to create a predetermined angle between said first and second regions to form the required three-dimensional shape,.

(iii) curing the bracket.

2. A method of forming a bracket according to claim 1 wherein the bending operation and curing are concurrent.

3. A method of forming a bracket according to claim 1 wherein the bending operating is completed before curing begins.

4. A method of forming a bracket according to any preceding claim wherein the forming tool can be set to create different values of said predetermined angle allowing different three-dimensional shaped brackets to be formed.

5. A method of forming a bracket according to any preceding claim including the step of undertaking a further bending operation to bend the blank about a further fold line.

6. A blank cut from a sheet of composite material for forming a bracket having at least one fold line defining first and second regions of the blank so that when the blank is bent about the at least one fold line creating a predetermined angle between first and second regions a three-dimensional bracket is formed.

7. A blank according to claim 6 which is substantially Z-shaped.

8. A bracket formed from a single sheet of composite material cut into a pre-determined shape.

9. A bracket according to claim 8 wherein the sheet of composite material includes at least one fold line defining first and second regions of the bracket about which the sheet has been bent to form a three-dimensional bracket shape.

10. A bracket as formed from a blank according to claims 6 or 7.

11. A tool for forming a bracket according to any of claims 8 to 10 comprising two surfaces on which the blank is placed connected by a hinge, the fold line of the blank being aligned with the hinge, and the hinge being set to allow the blank to be bent to the predetermined angle to form the three-dimensional bracket required.

12. A component made from composite material having an integral bracket, said bracket formed from a shaped sheet of composite material having at least one fold line defining first and second regions of the bracket about which the material has been bent to form a three-dimensional bracket shape.

13. An aircraft wing, rib and stringer arrangement including a series of brackets wherein each bracket in the series is formed from composite material cut to the same general profile.

14. An aircraft wing, rib and stringer arrangement according to claim 13 wherein the series of brackets are bent to different angles around a fold line on the sheet material during forming, the angle being set by an angle at which the rib and stringer are joined by each bracket meet.

15. An aircraft wing including a structure having a series of brackets according to claims 8 to 10.

16. A method of forming a bracket as substantially hereinbefore described with reference to figures 5 to 10.

17. A bracket as substantially hereinbefore described with reference to figures 5 to 10.

18. A blank as substantially hereinbefore described with reference to figures 5 to 10.